Section 5: Stream Crossings

Remember: ***This is the 'hot zone.' History has shown that if something goes wrong at a stream crossing, chances are that there will be a water quality problem.***

FPG ***There are several sections of the FPGs that apply to stream crossings.***

RULE ***Also refer to the riparian buffer rules and the laws on stream or ditch obstructions.***

Overall Stream Crossing Goals

- Minimize the number and use of crossings.
- Minimize the amount of bare soil exposure.
- Cross at right angles to the stream.
- Cross at a straight, narrow section of channel.
- Keep approaches on relatively flat ground.
- Routinely pack down leftover logging debris atop the approaches to control runoff and erosion.
- Minimize heavy equipment usage.
- Maintain streamflow at the crossing.
- Promptly stabilize crossings and approaches.
- Remove crossings as soon as possible if not needed.

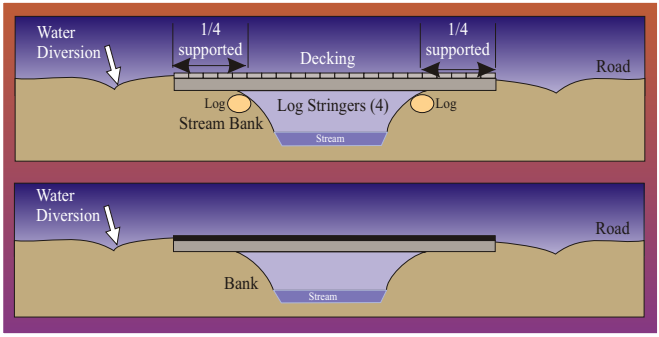
Avoid the need for stream crossings.

Bridgemats

- Create a solid-surface platform. Use clean logs or another bridgemat panel for the center section.
- Butt the edges of bridgemats tightly together to reduce the gaps between panels. This keeps debris from falling down through the gaps and into the water.
- Set bridgemats upon firm, stable banks.
- Minimize over-hang from log trailers or skidded logs and trees to reduce damage to the stream banks.

Steel bridgemats used on a skid trail stream crossing. Contact the nearby N.C. Forest Service district office to check on the availability of bridgemats to borrow, and learn more about proper stream crossing techniques.

Logs are laid on each side of this bridgemat crossing to catch debris from rolling off the mats. Three panels are used to create a solid-surface crossing platform and keep debris from falling down between the panels.



Ends are well supported. Bridgemat panels are butted tightly together. Debris is kept out of the stream.

Bridgemats are slipping. There is a gap between panels, allowing soil and debris to fall into the creek. Debris is being dragged into the creek by the skidding.

Three bridgemat panels are used to make a full-width, solid surface crossing platform. This will keep soil and debris out of the stream.

Improper center gap allows debris and soil to get dragged into the stream. There should be another panel, or log stringers, added to fill in the center gap.

Stream Crossings

Bridgemats or similar panels are good for making roadside ditch crossings.

Bridgemat panels are butted tightly together to keep debris out of the creek. An extra bridgemat panel is used on the approach to the crossing, protecting the stream bank's structure. (lower left corner in photo).

Ditch crossing with steel bridgemats and wooden road mats. Clean logs support overhang from trailer wheels. The ditch bank structural integrity is maintained.

Poor crossing with brush and soil plugging the ditch. Ditch bank structure appears weakened by equipment and could cave in. Extensive rehab will be needed.

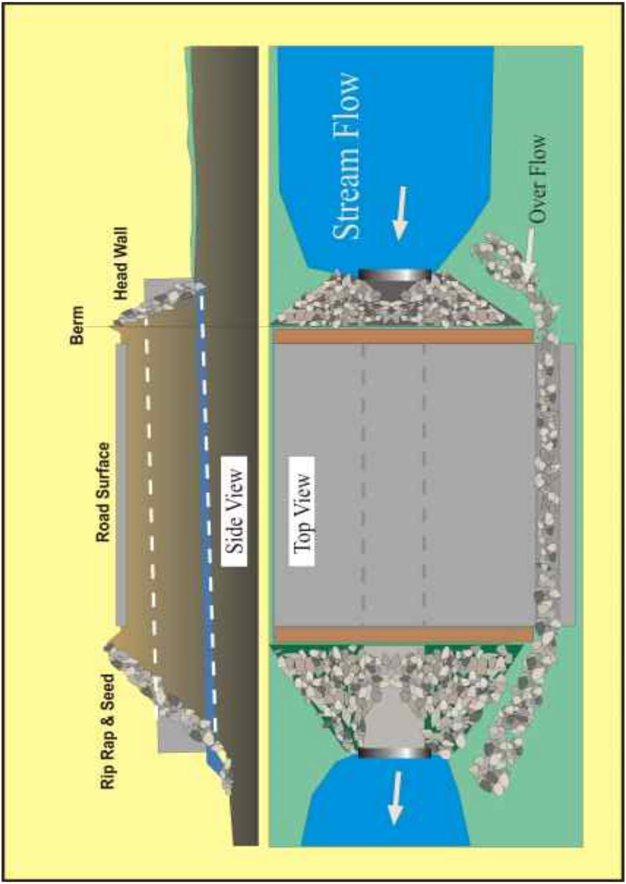
Culverts

- Use proper diameter culverts: minimum size is 15 inches. Refer to the appropriate sizing table for temporary or permanent installation.
- Extend the ends of the culvert at least 12 inches beyond the roadbed or skid trail pathway.
- Align the culvert to maximize the amount of streamflow through it.
- Set the culvert on a slight downgrade to aid in drainage and reduce debris blockages.
- Minimize the amount of 'waterfall drop' at the culvert outlet to prevent scouring of the soil.
- Backfill over with at least 1-foot of fill, or one-half the culvert diameter for large diameter pipes.
- Use and pack suitable backfill to minimize air pockets.
- Create overflow floodways at the approaches to the culvert so high stream water can flow around the crossing while avoiding a 'blowout' at the crossing.
- Harden the headwalls and/or surface as needed.

Avoid using an undersized culvert.

Remember: ***You cannot simply add together the diameters of two smaller culverts to achieve the same opening as a larger pipe. A single 30-inch culvert creates a larger opening than two 15-inch culverts.***

The following tables and sketch can be used as references for choosing a suitable culvert diameter



Berm
Head Wall
Road Surface
Rip Rap & Seed
Side View
Top View
Stream Flow
Over Flow

Temporary Culvert Sizing Table for Forestry

- Temporary culvert installation is based upon normal 1 to 3 year interval storm flow event.
- Use this table during dry periods, with low soil moisture and when no rain or snow is expected.

Average Channel WIDTH (inches)	Average Channel DEPTH (inches) 6	12	18	24	30	36	42
12	15	18	18	24	24	30	36
18	15	18	24	24	30	30	36
24	15	24	30	30	36	36	48
30	18	24	30	30	36	48	48
36	18	24	30	36	48	48	48
48	24	30	36	48	48	48	60*

**Consider alternative methods such as bridging, fords or multiple smaller pipes.*

Refer to the following stream channel cross-section sketch to see how to measure Average Channel Width and Depth used in this table.

Measuring a Stream Channel for Temporary Culvert Sizing

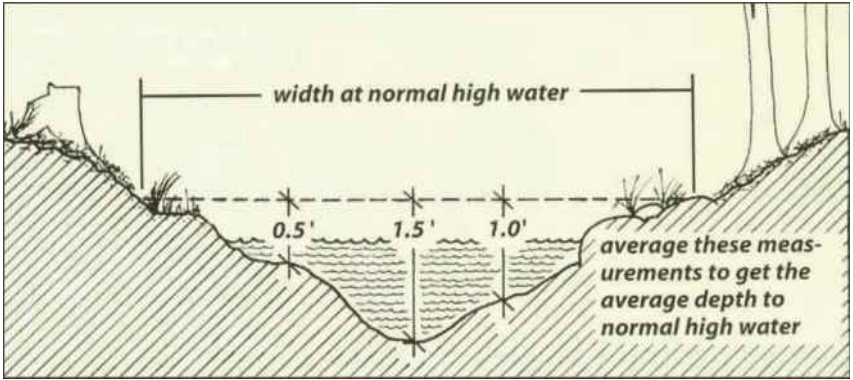


Illustration above reproduced from "Best Management Practices for Forestry: Protecting Maine's Water Quality". Maine Forest Service, 2004.

WIDTH = Average channel width at the normal high water mark
Do not simply measure how wide the water is in the channel.

DEPTH = Average channel height from the normal high water mark to the channel bottom. Do not simply measure how deep the water is in the channel.

Permanent Culvert Sizing Table for Forestry

- Use this table to select round culvert sizes for crossings that are expected to be in place for more than 1 year.
- This table is adapted from “Talbot's” formula of a 2.5-inch per hour rainfall.
- The letter “C” is in the table refers to the amount of expected runoff within the watershed area. Higher C-values means greater runoff volumes.

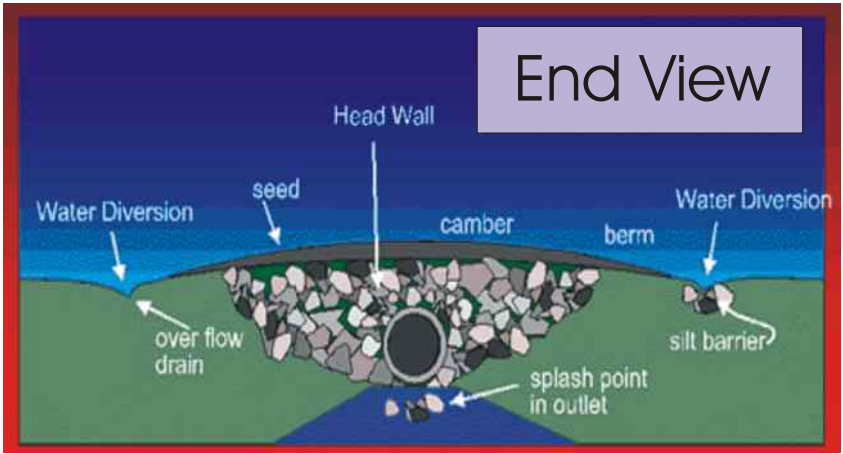
Up-stream Acres	*Impervious 100% runoff*	*Steep slopes, heavy soils, moderate cover*		*Moderate slopes, heavy to light soils, dense cover*		*Gentle slopes, agricultural-type soils and cover*		*Flatland pervious soils*
	C = 1.00	*C = .80*	*C = .70*	*C = .60*	*C = .50*	*C = .40*	*C = .30*	*C = .20*
2	15	15	15	15	15	15	15	15
4	18	18	15	15	15	15	15	15
6	24	18	18	18	15	15	15	15
8	24	24	18	18	18	15	15	15
10	30	24	24	24	18	18	15	15
20	36	30	30	30	24	18	18	18
30	42	36	36	30	30	24	18	18
40	48	42	36	36	30	30	24	24
50	48	42	42	36	36	30	24	24
60	*36+36*	48	42	42	36	36	30	24
70	*30+30+30*	48	48	42	42	36	30	24
80	*36+36+24*	*30+30+30*	48	48	42	36	30	30
90	*48+48*	*36+36*	48	48	42	42	36	30
100	*48+48*	*36+36+24*	*30+30+30*	48	48	42	36	30
150		*48+48*	*36+36+36*	*36+36+24*	*30+30+30*	48	42	36
200			*48+48*	*36+36+36*	*36+36+36*	*30+30+30*	48	36
250						*36+36+36*	48	42
400							*36+36+24*	48
500							*36+36+36*	*36+30+30*

Stabilized headwall with stone and grass. End of culvert extends beyond roadside edge. Culvert is installed to allow streamflow during dry times, but is large enough to handle normal storm flow.

No stabilization of the outlet. Soil is washing away and forming a gully. Pipe may not be large enough or long enough. Pipe appears to be too high, which allows water to scour the soil.

Culvert pipe is too short, and the outlet area is not stabilized. The soil on the road bank will quickly erode from the water flowing out of the pipe. Road bank collapse and failure will likely occur, which can transport volumes of sediment downslope into a stream.

Remember: ***A culvert pipe that is too long can also create problems. If the outlet is perched too high, the force of the falling water can scour away the soil and move sediment in the stream.***



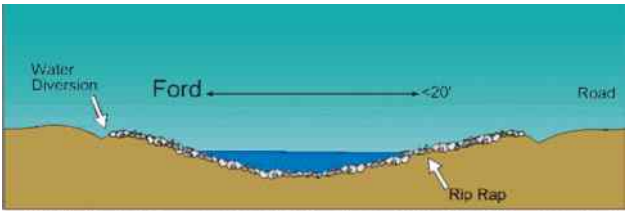
This sketch shows the outlet and end view of a properly installed culvert. Water diversions are used to direct runoff away from the stream. Overflow areas are established to carry floodwaters. There is ample fill material atop the culvert and headwalls are armored. Bare soil is seeded and stabilized.

Fords

- Use clean rock or other suitable materials. You may need to first lay down geotextile fabric or honeycomb webbing as a base, to prevent the rock from getting compressed into wet, organic or muck soil.
- Spread material level across the stream bottom.
- Establish a shallow trough along the centerline of the water's pathway, so water can flow during dry times.
- Stagger the tire tracks of traffic through the ford. This minimizes rutting at the crossing.

Do not use fords for skid trail crossings.
Do not obstruct streamflow.
Do not use asphalt-based materials.

This ford crossing has ample, clean stone on the approaches and is being used during relatively low-flow stream currents.



Stone may be needed along the road approach and to armor the water diversions.

Gently sloping road approaches. Ample stone surfacing material. Grassed road banks stabilize the soil. Crossing is at a right angle and at a narrow stream section. A shallow trough is left within the centerline of the stream's channel to allow water flow during dry times.

Stream Crossings

Do not use streams as skid trails or roads!

Don't let this happen to you!

Even with stone on the road, there is sediment getting into the creek. Reconsider your options if you are forced to push or pull trucks through a ford crossing.

BEFORE: Road surface is bare soil. Stream bank is unstable. Crossing location is shaded and too narrow.

AFTER: This is the same location as above, after BMP work. Road surface is graded and stabilized with stone. Crossing has been slightly widened and daylighted (note the sun shining through the water.) Stagger tire tracks through a ford to minimize rutting of the stream bottom.

BEFORE: Ford approach is seeded and mulched immediately after installation. Try to install fords before you need them, to allow time to settle and the soil to stabilize.

AFTER: The road and approach to the ford have complete coverage with vegetation groundcover.

Pole Crossings

Remember: ***Pole crossings are usually most appropriate for temporary access on ditches or ephemeral drains.***

- Allow water to maintain flow through the crossing.
- Use only topped and de-limbed logs that are free of excessive soil or debris.
- Use logs that are large enough so they do not pack too tightly together. An ideal diameter size range is logs of 10 to 12 inches or larger.
- Stack the pile of logs a little higher than the channel bank height. That way, when the logs pack down, the structural integrity of the channel bank will remain.
- Immediately remove the crossing when it is no longer needed or when significant precipitation is forecast for the upstream watershed area.

- ***Crossing must not obstruct the flow of water.***
- ***Do not place soil on top of the pole crossing.***
- ***Pole crossings are not suitable for either an intermittent stream that has water or for any perennial stream.***

Timesaver Hint:

Arrange your logs across two or more outstretched cables or chains and create a bundle. Install the bundle for the crossing. To remove the crossing, simply pull the cable or chain to lift and remove the entire bundle.

Pole crossing installed in a dry ditch. Large, clean logs are used with wooden road pallet mats to support log truck traffic. Soil is not placed atop the logs.

Stream Crossing Rehab

- **Plan accordingly.** Each stream crossing will need some amount of rehab work, not just the ones where there is a problem.
- **Pay a little now or a lot later.** Use BMPs right-from-the-start of your operations to help protect water quality. Plan to reduce your needs and costs for extensive rehab.
- On skid trail crossings, drop and pack down leftover limbs, tops, laps, or slash upon the approaches to the stream crossing with each pass of the skidder. **This technique can be very effective when used together with other erosion control practices to keep sediment and debris out of the stream.**

These two skid trail stream crossings have leftover limbs packed on the approaches, creating a cushion atop the soil surface and helping to prevent runoff and erosion.

Stream Crossings

A stream crossing done correctly. *No debris is in the stream. Stream banks are stabilized with seed and mulch.*

Don't let this happen to you! *Soil is plugging the stream channel. No erosion control on the approaches. This improper skid trail crossing will lead to water quality problems and requires extensive rehab work.*